Re-working Appleyard in a low density environment: An exploration of the impacts of motorised traffic volume on street livability in Christchurch, New Zealand.

Wiki J., Kingham S., and Banwell K.

1. Introduction

The majority of the developed world's population live on streets, using them to transport and access the essential elements of life. The way in which such spaces are used is complex and constantly evolving to suit societal and environmental norms. As urban sprawl continues to intensify there are increasing numbers of people living away from diverse and pedestrian-orientated streets. In some areas the neighbourhood has become vehicle-orientated and considered no longer as a place of social connection and value. Such relationships have been recognised worldwide with research in San Francisco among the first to clearly demonstrate that motorised traffic volume can decrease street livability, have negative social consequences and impact significantly on community wellbeing (Appleyard, 1980).

Such relationships have also been recognised within New Zealand. Kingston et al (1982) sought to identify the extent to which awareness of motorised traffic, effects of motorised traffic on life and activities, and feelings about motorised traffic increase in proportion to volume, resident response to volume, and the thresholds at which these change. Results showed that vehicle speed and volume promote a predominantly negative social response, with the perceived health effect of heavy volumes as a dominant concern (Kingston et al, 1982). Despite the limited nature of this study they did arrive at significant conclusions, confirming that the negative social effects of motorised traffic volume found by Appleyard (1980) were also present in New Zealand. More recently, research by Tranter and Pawson (2001) found that motorised traffic volumes impact significantly on children's freedom in Christchurch. They noted that a place where there needs to be an emergence of values in Christchurch is in "[the] traditional role of the street as a place for social interaction and community integration" (Tranter and Pawson, 2001, p46). The need for a revitalisation of such values has been noted since the 1980s yet vehicle use is still dominant and very evident throughout Christchurch. The lack of freedom and fear of endangered safety this generates for pedestrians, particularly children, has led to life becoming increasingly privatised with a significant proportion experienced inside the home. To assess street livability and community severance within Christchurch it is necessary to consider the role that motorised traffic plays and understand if the relationships between traffic volumes and social harm found in previous research are present in contemporary Christchurch.

This study utilised a similar approach to Appleyard's work of the 1970s and 80s, collecting data from streets of varying traffic volume and examining the impact of motorised traffic on community liveability and wellbeing. It was conducted in Christchurch, New Zealand, a city of 350,000 people. Population density is low, car use high and many residential streets are wide. In many ways, it is similar to many medium sized towns and cities in more recently urbanised parts of the world such as North America and Australasia, and very different to San Francisco and European cities where similar studies have been conducted.

2. Literature Review

> "We have taken the creative crucible of the city – its streets – and handed them over to a form of movement which destroys both the essential elements of creativity: diversity and spontaneity" (Engwicht 1999, p30).

Streets, holding the dual function of exchange and movement, were once, and in some cases still are, a significant part of the individual and community's urban environment. Motorised traffic has changed the traditional roles of streets however, a paradigm shift has occurred where what was once considered safe for social interaction and play are now often viewed as dangerous and impersonal. It is argued that this is largely due to increases in motorised traffic, and while vehicles have enabled improved access for many the quality of life in other areas has been eroded by their presence (Marsh and Watts, 2012). This is particularly true of the public space

outside the home, the street, where carrying vehicular traffic has become the accepted purpose. Engwicht (1999) argues that the introduction of the vehicle has converted streets into the single function of movement only, decreasing the opportunity and diversity of social and cultural human exchange and forcing society into polarized intimacy with significant losses in casual community contact.

This is also referred to as community severance where motorised traffic speed, volume or infrastructure acts as a psychological or physical barrier to community interaction by inhibiting access to goods, services and people (Boniface et al, 2015; Mindell and Karlsen, 2012). The health impacts of community severance have been discussed by Boniface et al (2015) with emphasis on the effect of transport on social interactions and the impact this has on individual and community health and quality of life. Additionally, Mindell and Karlsen (2012) found through a comprehensive literature review that community severance impacts significantly on street livability, travel and social networks and it is suggested that such impacts directly contribute to poorer health. Community severance has various understandings and interpretations however and Anciaes and colleagues (2015) acknowledge that there is a lack of consistent guidelines for the identification and solution to issues of community severance. Furthermore, there is a lack of consistency and use of quantification measures demonstrated by Anciaes and colleagues (2015) discussion surrounding techniques and the sensitivity of input variables on quantification.

A wealth of literature demonstrates the importance of recognising that the residential street should be viewed as a neighbourhood, a destination and social centre, rather than a channel for vehicles (Appleyard, 1980; Hart and Parkhurst, 2011). Appleyard (1980) found significant differences in the social nature and liveability of streets with varying traffic volumes. He found that motorised traffic does more than just take over physical space; it has a zone of influence that controls a space psychologically, and as vehicle speed and volume increase, the zone of influence and home territory shrinks. He further argued that street livability is enabled in protected neighbourhoods which require the right of way for pedestrians and enforce acceptable traffic speeds, volumes, and noise levels. Bosselmann et al (1999) and Hart and Parkhurst (2011) replicated Appleyard's study, looking at residential streets in the USA and UK respectively, and showed similar results to Appleyard's (1980), demonstrating that motorised traffic acts as a barrier to street liveability and social interaction. This emphasizes that such research is still applicable to varying contexts today.

A number of studies have also demonstrated the impacts of motor vehicles on health and wellbeing (Dora and Phillips, 2000; Gee and Takeuchi, 2004; Marsh and Watts, 2012). Gee and Takeuchi (2004) examined relationships between traffic stress, vehicular burden, health and wellbeing in urban populations and found that people living in areas with high vehicular burden reported not only the most traffic stress, but also the lowest health status and increased depressive symptoms. A number of studies including Dora and Phillips (2000) have examined the effects of vehicle pollution on health and wellbeing and found that the consequences of motorised traffic volume and transportation systems go beyond the individual, having the ability to affect the health and wellbeing of communities. In addition, motor vehicles can lead to injuries from accidents and a reduction in physical activity which is associated negative health outcomes.

3. Methods

The research presented in this study adopts Appleyard's (1980) approach of street observations coupled with resident questionnaires and interviews, to examine the impacts of motorised traffic volume on street liveability and community severance within the context of Christchurch, New Zealand. To gather information on residents in the chosen streets, a survey was distributed to residents in seven study sites on six streets, with options of both paper and electronic completion. Respondents were also invited to participate in further, in-depth interviews. The six streets were broken into seven study sites as one street, Grants Road, had two study sites due to significantly differing traffic conditions on the length of this road. Observations of all study sites and their surrounding areas were used to construct figures reflecting the environmental layout and ambience of each study site. Such figures

were based on those used in comparative studies (Appleyard, 1980; Bosselmann et al, 1999; Hart and Parkhurst, 2011), and were used to demonstrate the extent to which traffic volumes affect where residents consider their local home area to be and to show their neighbourhood connections.

Motorised traffic volume levels were based on the New Zealand Transport Agency's (NZTA) Code of Practice for Temporary Traffic Management (CoPTTM, Fourth Edition, Second Amendment), which has been designed in line with the Road Controlling Authority guidelines for designating road levels and has been effective since July, 2013. The CoPTTM describes annual average daily traffic (AADT), with level 3 classification indicating the highest volumes. Level 3 roads are not included in this research project, but to indicate their measure they are associated with high volumes, high speed and multi-lane roads and motorways that are typically divided by a carriageway with average speeds exceeding 75kmh (NZTA, 2013). Each street for this study was selected because they had varying traffic volume counts accessed using CCC data available on level 2, level 1 and low volume classification roads (CCC, 2012/13) (Table 1). As noted, there were six streets with seven study sites in total, with Grants Road broken into two study sites (Table 1).

	Study Classification	NZTA Classification	Traffic Volume (VPD†)
Milton Street	heavy	level 2	13,720
Grants Road (a)	heavy	level 2	8,400
Grants Road (b)	moderate	level 1	2,500
Roker Street	moderate	level 1	1,400
Proctor Street	light	level 1	500
Taunton Green	light	low volume	150*
Stenness Avenue	light	low volume	100*

Table 1: Traffic Volume and Street Information
* CCC does not display accurate information for counts of less than 500 VPD, estimated numbers only.
† Vehicles per day, two way traffic volumes.

	Heavy	Moderate	Light	Total	
	N	*N*	*N*	*N*	%
Gender					
Female	10	11	10	31	59.6
Male	6	9	6	21	40.4
Age					
<30	0	0	0	0	0
30 - 39	3	2	0	5	9.6
40 - 49	2	3	2	7	13.5
50 - 59	3	10	7	20	38.5
60+	8	5	7	20	38.5
Ethnicity					
NZ European	12	15	15	42	80.8
Asian	1	2	0	3	5.8
MELAA	0	1	0	1	1.9
Other*	3	2	1	6	11.5

Table 2: Descriptive Information
*Included European, Canadian, English, Irish, Scottish

4. Results and Discussion

There were 52 respondents involved in this research, a fairly small response rate for the given areas; 16 from the heavy traffic streets, 20 from the moderate traffic streets, and 16 from the light traffic streets. Interviews were conducted with eleven residents; two from light trafficked streets, five from moderately trafficked streets, and four from heavy trafficked streets. There were slightly more female respondents than male and the mean age of respondents was 50.6, with the majority of respondents aged above 50 and none below 30. The majority of respondents, 80.8%, were New Zealand European with only small percentages of Middle Eastern, Latin American and African (MELAA), Asian and other ethnicities (Table 2). Addition-

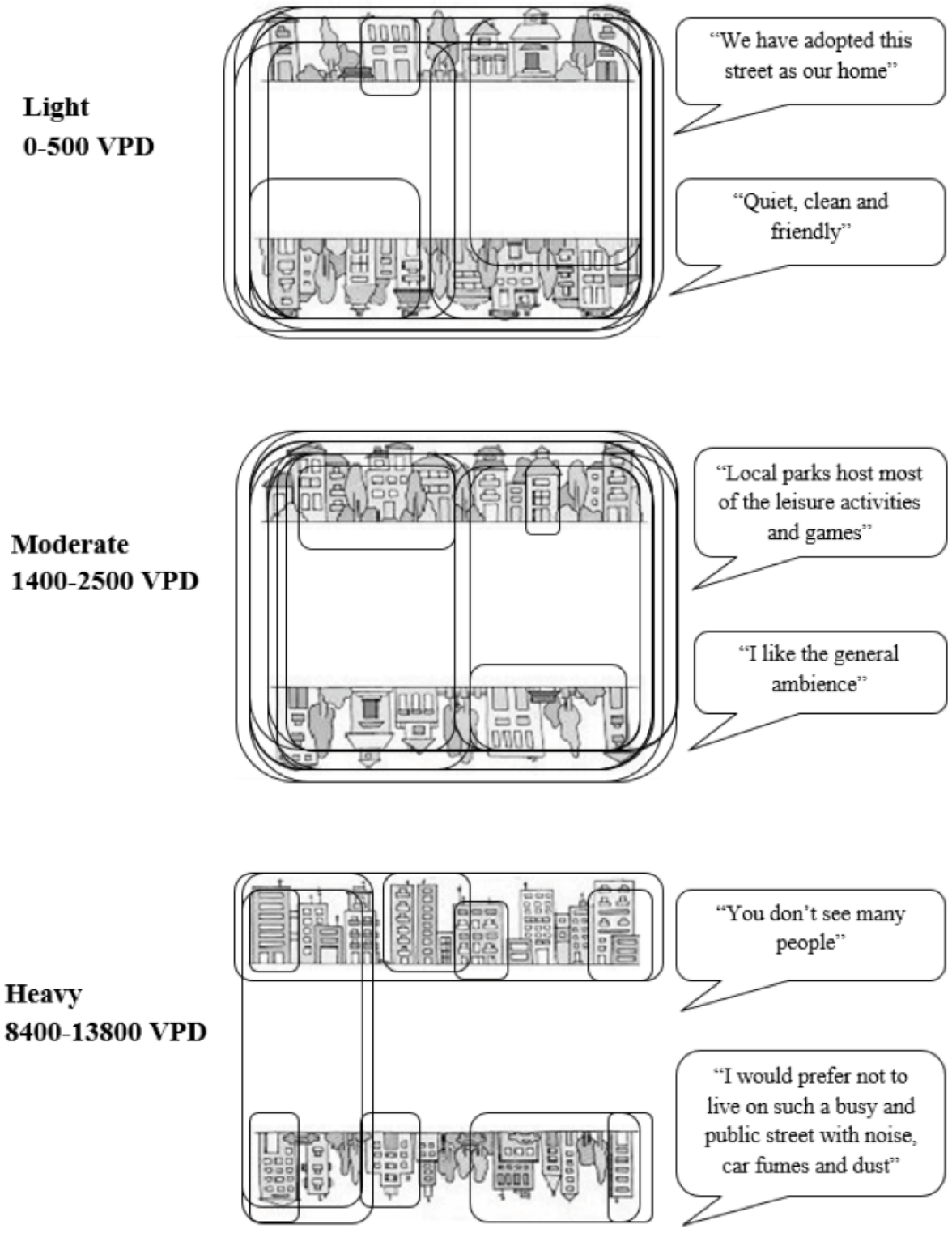

Figure 1: Local Home Areas

ally, there were no respondents of Māori or Pacific ethnicities which was surprising given that these two ethnic groups make up a significant proportion of New Zealand residents.

4.1 Home area

Light and moderately trafficked streets commonly had local home areas extending into the street or beyond, with many respondents noting local recreational areas and greenspaces as areas of particular importance (Figure 1). Additionally, heavy trafficked streets had significantly smaller local home areas with the majority only encompassing the respondent's house or part of their side of the street, emphasising the barrier effect motorised traffic can have in residential areas. Comments given during interviews describing the street image for light and moderately trafficked streets demonstrate that the most common feelings associated with these street environments were positive, indicating an appreciation of the quality and nature of the streets with low traffic volumes (Figure 1). Conversely, responses from heavy trafficked streets have predominantly negative connotations, indicating a dissatisfaction with the street environments in areas of heavy traffic volume (Figure 1). This is an important consideration when discussing street liveability as the perceived image and nature of the street contribute to the way it is viewed, and subsequently used, by both residents and visitors.

The perceived negative liveability impacts of motorised traffic volume can also alter the way in which the street is utilised. In this research, street utilisation was judged on a scaled index score based on responses to five variables; restricting children from playing and crossing the street, accompanying children to school, going out on the street less often, sitting outside less frequently, and having a fenced property. There was a significant relationship, indicating that as motorised traffic volumes rose residents were increasingly aware of the impact it was having on the liveability of their street ($R^2 = 0.18$, $p = 0.02$).

4. 2 Community Severance

To understand the effect of motorised traffic volume on community severance, re-

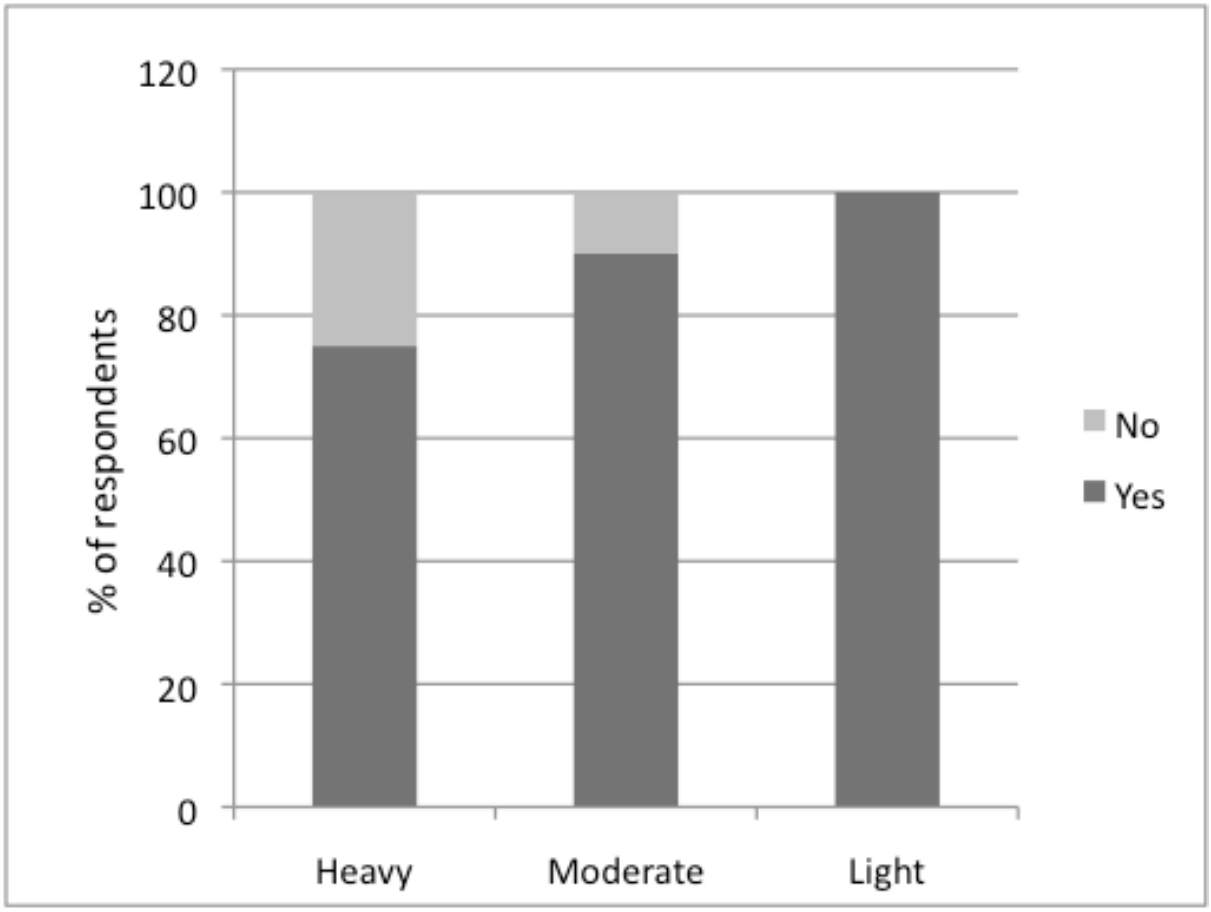

Figure 2: Sense of Belonging

spondents were asked to indicate if they felt a sense of belonging to their street and community or not (Figure 2).

This shows that as motorised traffic volume increases, the proportion of residents who feel a sense of belonging to their street and community reduces slightly. While other factors may have contributed to this relationship, motorised traffic volume can act as a barrier to social interaction by taking away the street space both physically and psychologically as discussed by Engwicht (1999). While motorised traffic volumes seem to be impacting on the relationship with community belonging within this study further research is required to understand the extent of this and what other factors are involved. Respondents were also asked to indicate on a map of their street the number and location of neighbours they knew or had connections with. These maps were transformed into representative images to protect the confidentiality of respondents (Figure 3).

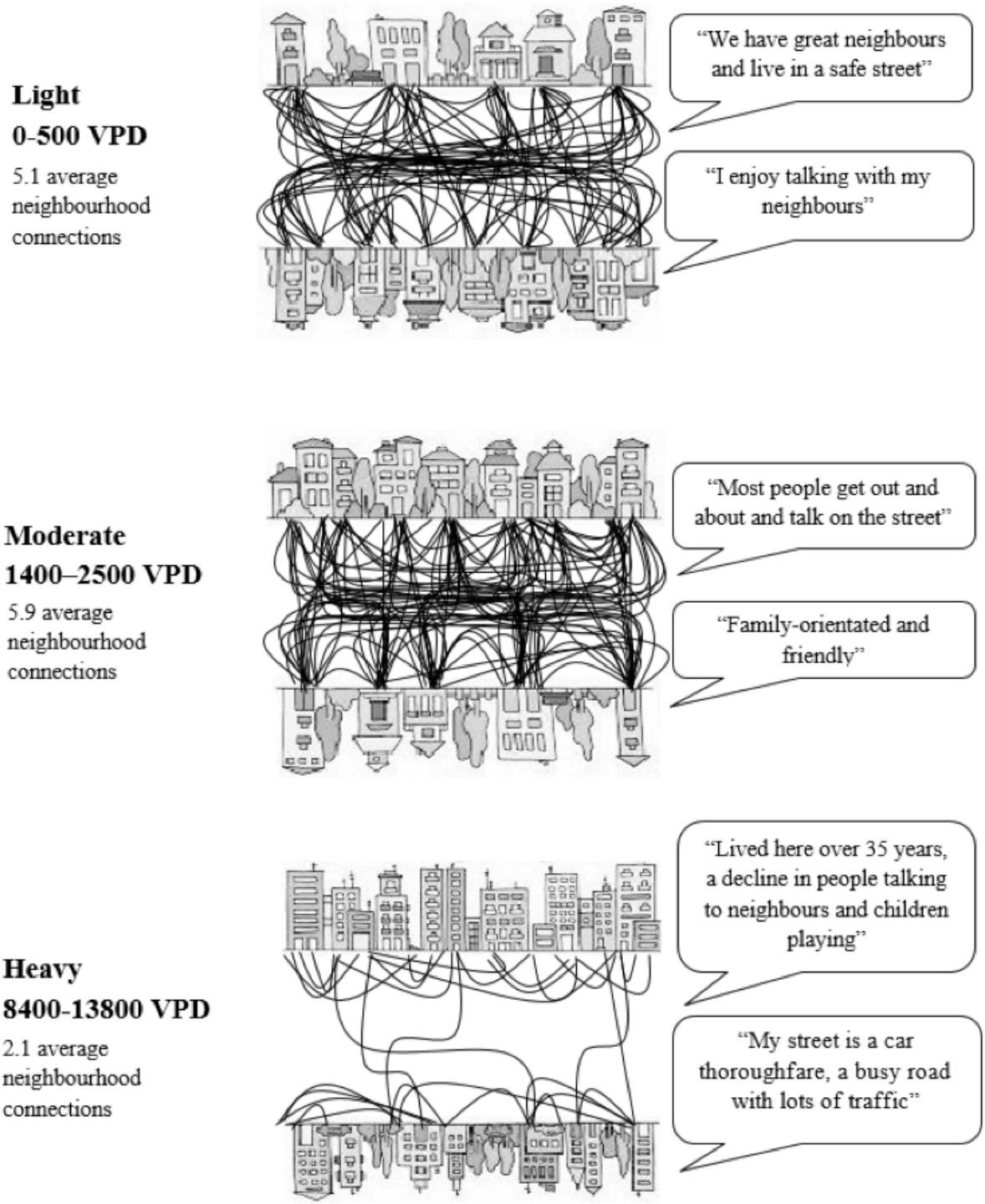

Figure 3: Neighbourhood Connections

Light and moderately trafficked streets had high numbers of neighbourhood connections, with an average of 5.1 and 5.9 respectively, extending to both sides and ends of the street (Figure 3). Heavy trafficked streets were shown to have an average of only 2.1 neighbourhood connections however, significantly less than those of the light and moderately trafficked streets. Additionally, neighbourhood connections on heavy streets are shown to centre on one side of the road only with only five connections extending to the other side of the street, once again demonstrating the barrier effect of motorised traffic volumes in residential areas (Figure 3). Comments from respondents on heavy trafficked streets demonstrate that motorised traffic volume acts as an inhibitor to community interaction with a decline in people talking and children playing, and the street being viewed predominantly as a place for vehicles. Comments from respondents on moderate and light trafficked streets are shown to have very different perceptions of the social interaction within their neighbourhood and community however, with the majority of respondents commenting on the regularity of social interactions. The distinct differences in community interaction between the study streets demonstrates the impact and restrictions that motorised traffic volumes are having on this aspect of community severance within Christchurch.

While neighbourhood connections are an important aspect when discussing community severance, the level of neighbourhood interaction is also important to consider as it reflects not only how many residents know each other but how often they stop to interact. An indication of how often respondents involved in this research interact with others in their street and community can be seen (Figure 4).

Respondents from all streets had occasional community interactions, while respondents from light and moderate trafficked streets had significantly more frequent interactions, and respondents from heavy trafficked streets were more likely to never have interactions within their community (Figure 4). Motorised traffic volume may be a contributor to this relationship as it restricts residents from using the street space outside their home as an area for community interaction.

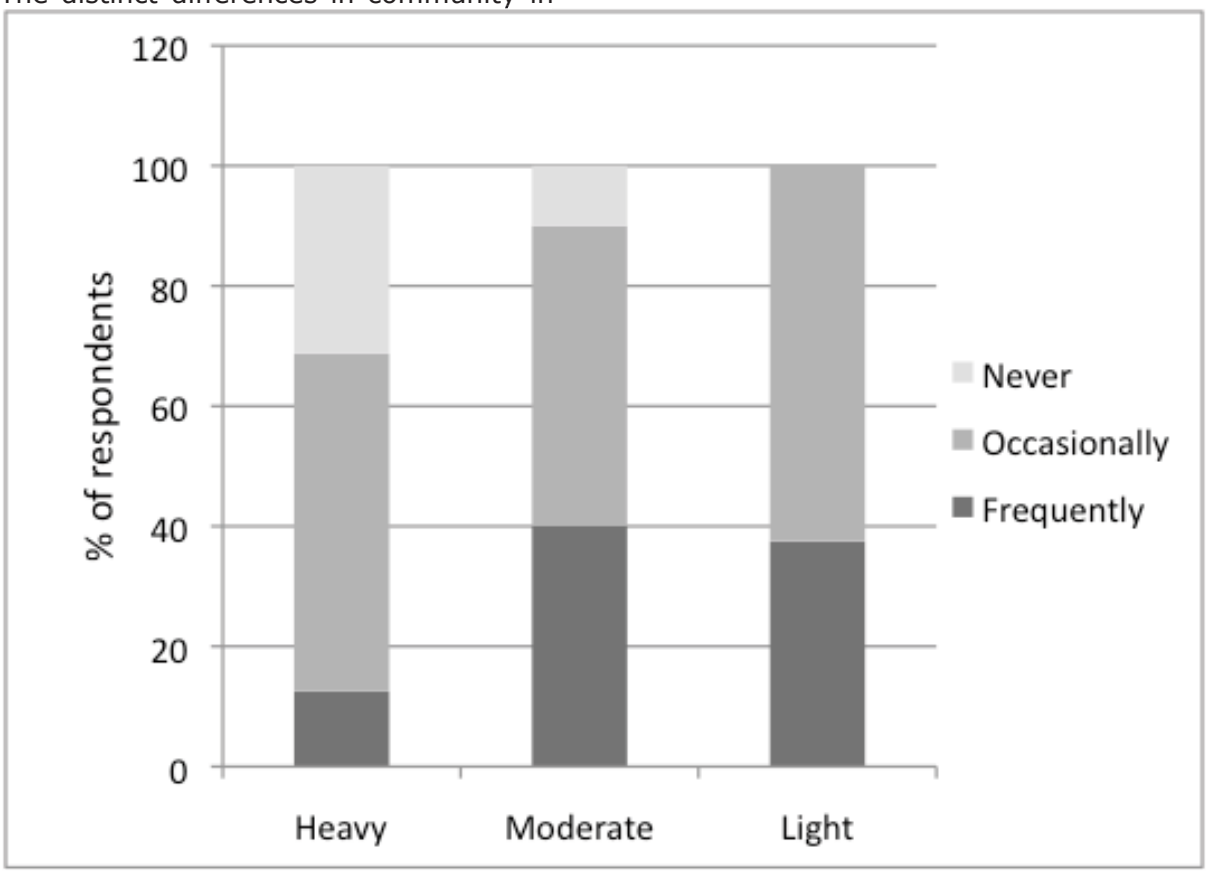

Figure 4: Community Interactions

The level of community annoyance within the research areas was also used as a measure to judge the community severance impacts of motorised traffic. Community annoyance was based on responses to the level of annoyance felt by the following factors around their home; dangers affecting children, motorised traffic noise and vibration, lack of greenspaces, lack of contact with others, and motorised traffic volumes. The only significant finding was regarding the traffic volume variable, indicating that as motorised traffic volumes rose residents were increasingly annoyed by its presence ($R2=0.17$, $p=0.001$). Respondents were also given the opportunity to note other factors that contributed to annoyance including on-street parking and general neighbourhood noise, however the majority of respondents noted motorised traffic as their primary source of annoyance.

5. Limitations

There are various limitations implicit in this study, including that the research areas within Christchurch are limited in number, and data collected from this study is not fully representative of the population within either the research areas or greater Christchurch. The sample size of 52 is too small to confidently draw causal inferences from and the response rate was fairly small, indicating that findings would be more robust if gathered from a larger sample of residents within the study sites. Additionally, there were no respondents of either Māori or Pacific ethnicities or of younger age groups. While this may have reflected the demographic nature of the chosen study areas it is an important consideration for both this study and future research. Further research should also control for confounding variables to strengthen findings. The accuracy of data over time and space also needs to be taken into consideration, presenting a further limitation of this study as the data used for both motorised traffic volume and demographic information are from 2013 and may not accurately reflect the current situation within Christchurch. Motorised traffic volumes levels are based on classification by average annual daily traffic and reflect counts which do not take into consideration temporal and seasonal variations or the substantial effects of changes in road closures and traffic diversions due to post-earthquake circumstances and road repairs. Additionally, while being broken into intersectional counts for heavily travelled or long streets, it does not take into account varying traffic volumes which can be present within segments of some streets, particularly those less travelled, something that was notable in observations of moderate streets involved in this research. Further research, wider research areas, and up to date data is needed to give a better indication of accurate motorised traffic volumes within Christchurch and their causal relationship with street liveability, community severance and health.

6. Conclusion

Streets and roads are where the majority of the world's population live, and are also how a large proportion of the world's inhabitants access the essential elements of life. How we use such spaces has evolved within varying contexts over time to suit societal and environmental norms, demonstrating the complex nature of the street space, its use, and the impact it can have on populations. This is particularly important when discussing residential spaces and communities where increasing motorised traffic volumes in the street space have been shown to impact significantly on livability and community severance worldwide since the 1970s and 80s, with many areas implementing urban designs and initiatives to minimise the negative impacts of vehicular dominance. While there are many other factors which impact on these relationships, research from varying contexts has identified the repressive and pervasive effect that motorised traffic can have in residential spaces.

This research sought to understand the extent to which motorised traffic volume was impacting on such relationships within contemporary Christchurch, examining the effects on street liveability and community severance. Results indicate that residents on light and moderate trafficked streets have more neighbourhood connections and community interactions in addition to perceiving their street to be more liveable. Furthermore, residents on heavy trafficked streets were shown to have a negative perception of their street environment, smaller local home areas and a

decreased sense of belonging to their community. This affirms relationships found in previous research, indicating that increasing motorised traffic volumes can have significant impacts on street liveability and community wellbeing. Ideally further research will be conducted to address the limitations of this study and specifically assess the impact of motorised traffic on community wellbeing in a more overt and substantive way.

Acknowledgments
This research was partially funded by the New Zealand Ministry of Business, Innovation and Employment (MBIE) 'Resilient Urban Futures' programme.

Author details:
Wiki J., Kingham S., and Banwell K.
Dept. of Geography,
University of Canterbury
Christchurch, New Zealand, 8140

Email:
simon.kingham@canterbury.ac.nz

References:

Anciaes, P. R., Jones, P., and Mindell, J. S (2015). 'Community severance: Where is it found and at what cost?' Transport Reviews, doi:10.1080/01441647.2015.1077286

Appleyard, D (1980). 'Livable streets: Protected neighborhoods?' Annals of the American Academy of Political and Social Science, 451 (1), 106-117.

Boniface, S., Scantlebury, R., Watkins, S., and Mindell, J (2015). 'Health implications of transport: Evidence of effects of transport on social interactions'. Journal of Transport and Health, 2 (3), 441-446.

Bosselmann, P., Kronemeyer, T., and Macdonald, E (1999). 'Livable streets revisited'. Journal of the American Planning Association, 65 (2), 168-180.

Christchurch City Council (2012). Road Level Classification List. Regulations 2012. Retrieved from: resources.ccc.govt.nz/files/RoadLevelClassificationList.pdf

Christchurch City Council (2012). Volume Count Search. Retrieved from: www.ccc.govt.nz/CCC.Web.TrafficCount/cityleisure/projectstoimprovechristchurch/transport/trafficcount/volumecount.aspx

Dora, C., Phillips, M., Danzon, M., and Molterer, W (2000). 'Transport, environment and health'. World Health Organization Regional Publications - European Series, (89), 4-54.

Engwicht, D (1999). Street reclaiming: Creating livable streets and vibrant communities. Annandale, NSW, Australia: Pluto Press.

Gee, G. C., and Takeuchi, D. T. (2004). 'Traffic stress, vehicular burden and well-being: A multilevel analysis'. Social Science and Medicine, 59 (2), 405-414.

Hart. J. and Parkhurst, G (2011) 'Driven to excess: Impacts of motor vehicles on the quality of life of residents of three streets in Bristol, UK', World Transport Policy and Practice, 17 (2), 12-30.

Kingston, Reynolds, Thom and Allardice Limited (1982). Traffic in residential streets: The social response. Wellington: Road Research Unit, National Roads Board.

Marsh, K. and Watts, C (2012) 'Literature review on community severance and social connectedness: Definitions, pathways and measurement'. NZTA. Sourced from: www.nzta.govt.nz/assets/resources2012

Mindell, J. S., and Karlsen, S (2012). 'Community severance and health: What do we actually know?' Journal of Urban Health, 89 (2), 232-246.

New Zealand Transport Agency (2013). Code of Practice for Temporary Traffic Management (4th Edition, Amendment 2). ISBN 987-0-478-40773-0. Retrieved from: www.nzta.govt.nz/resources/code-temp-traffic-management/docs

Tranter, P., and Pawson, E (2001). 'Children's access to local environments: A case-study of Christchurch, New Zealand'. Local Environment, 6 (1), 27-48.